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## Short Report

### Mosquito nets for the elderly?

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#### Abstract

Nine-year follow-up (ending 1999) of survival of 3738 individuals in a malaria-endemic area of Papua New Guinea found that the use of mosquito nets was associated with a large reduction in mortality in people aged  $\geq 40$  years as well as in children aged  $< 5$  years. There may be substantial benefits of malaria transmission reduction for older people, that have been overlooked in public health programmes and burden of disease calculations.

**Keywords:** malaria, *Plasmodium falciparum*, disease control, mosquito nets, mortality, elderly people, Papua New Guinea

Life-threatening malaria is generally considered rare in non-pregnant adults living in areas endemic for *Plasmodium falciparum*, since cerebral malaria is a disease of non-immune visitors and of older children and severe malarial anaemia is mainly associated with pregnant women and infants in areas of the highest malaria transmission. Adults in endemic areas are frequently parasitaemic but their parasite densities are generally much lower than those in children, and febrile illnesses in such adults are rarely associated with hyperparasitaemia. For these reasons, evaluations of mosquito nets against malaria have focused on the impact in small children.

We recently carried out an analysis of the parasitological effects of net use, using data on prevalence of malaria parasitaemia and entomology collected during 4-monthly cross-sectional survey between 1990 and 1992 in the Wosera district of Papua New Guinea, where the overall prevalence of *P. falciparum* parasitaemia is about 39% (GENTON *et al.*, 1995a). Mosquito nets, not treated with insecticide, had been in use in this area for a number of years. Participants in the malariological surveys were asked 'Did you sleep under a net last night?'. We defined net coverage as the proportion of replies from the house that were affirmative to this question. A single value for coverage was assigned for all individuals living in the same house, since this measure was a better predictor of prevalence

of *P. falciparum* parasitaemia than were individual-level responses (SMITH *et al.*, 2001).

Net coverage was associated with a substantial reduction in parasite prevalence (GENTON *et al.*, 1995a), and also with an increase in the age of peak prevalence of *P. falciparum* parasitaemia from about 5 years in areas with no mosquito nets to almost 12 years in places with complete coverage (SMITH *et al.*, 2001). Although the nets were not impregnated with insecticide, they also had substantial effects on entomological indices of malaria transmission intensity (HII *et al.*, 2001).

The 3738 survey participants whose net status could be assigned were all included in a Demographic Surveillance System (GENTON *et al.*, 1995b) and this enabled us to link the survival of each individual to net use, following up the participants until the end of 1999. Table 1 gives the numbers of people in each category of net coverage included in this analysis.

The associations between net coverage and survival are presented in Table 2, in the form of relative hazard estimates and significance tests from Cox Proportional Hazard regression models. Protection was statistically significant in children aged  $< 5$  years but the number of deaths analysed in those aged 5–39 years was too small for any clear conclusion to be drawn. A high coverage with nets was associated with substantial reduction in mortality in people aged  $\geq 40$  years (Figure).

Could factors other than malaria transmission reduction account for this association between net coverage and survival? We did not routinely collect net-use data during the follow-up, so the data collected during 1990–92 do not accurately reflect coverage during the whole period. Moreover, net users are generally people with better access to health-care facilities, and the use of nets may also indicate a greater general concern for health on the part of members of the household, irrespective of health service usage. However, socio-economic stratification in the area is very limited and the relationships between mortality rates and net coverage are so large that it seems unlikely that they can be completely explained by confounding with health facility usage patterns.

We have not yet analysed cause-of-death data, but since malaria is known to be associated with a high burden of indirect mortality (MOLINEAUX, 1985), it is possible that the use of mosquito nets could delay deaths even when malaria is not the proximal cause.

It therefore seems likely that nets offer genuine protection to people aged  $\geq 40$  years in the Wosera

**Table 1. Distribution of mosquito net coverage (1990–92) in the study area of Papua New Guinea**

Mosquito net coverage <sup>a</sup>	Number of people (%)
0	919 (25)
>0–<33%	530 (14)
33–<67%	687 (18)
67–<100%	870 (23)
100%	732 (20)
Total	3738 (100)

<sup>a</sup>Percentage using nets in the household.

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**Table 2. Mortality by age, assessed in 1999, in the study area of Papua New Guinea**

Age in years at baseline	No. of people	Person-years at risk	Total deaths	Mortality rate (/1000 person-years)	Mortality Rate Ratio (95% CL) <sup>a</sup>	Likelihood ratio $\chi^2$ statistic <sup>b</sup>
<5	772	5602.9	32	5.7	0.37 (0.15, 0.89)	5.0 (0.026)
5–19	1335	9842.3	19	1.9	0.63 (0.20, 2.0)	0.6 (0.4)
20–39	1010	7418.4	29	3.9	0.63 (0.25, 1.6)	1.0 (0.3)
40–59	452	3247	99	30.5	0.34 (0.19, 0.59)	14.2 (0.0002)
60+	169	1024.5	87	84.9	0.48 (0.25, 0.91)	5.0 (0.025)
Overall	3738	27135	266	9.8	0.44 <sup>c</sup> (0.31, 0.61)	16.8 (<0.001)

<sup>a</sup>Relative hazard associated with 100% net coverage compared with 0% net coverage. 95% CL, 95% confidence limits.

<sup>b</sup>Testing the coverage effect; d.f. = 1.

<sup>c</sup>Adjusted for age.

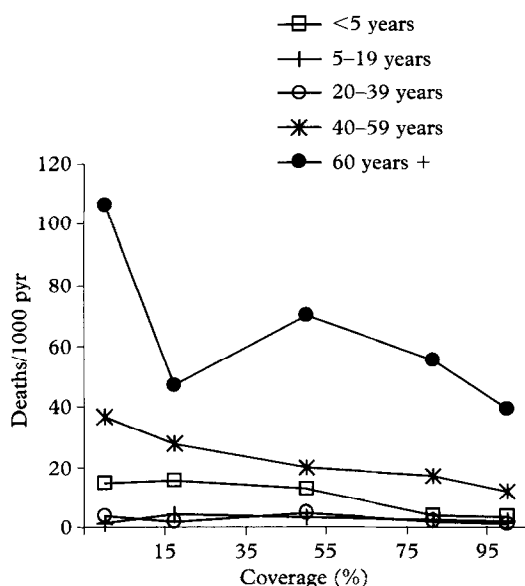


Figure. Mortality rates by net coverage and age-group (Papua New Guinea, 9-year study ending 1999). The age-groups refer to age at death (i.e. mortality rates were computed allowing changes of age-group during the follow-up period). pyr, Person-years at risk.

study area. Mechanisms controlling parasitaemia in adults in endemic areas may well weaken in old age, as a result of senescence of the immune system. However, there is a paucity of clinical epidemiological evidence on this point (SNOW *et al.*, 1999), since most malariological studies do not distinguish between young adults and those in their middle years or older. This suggests that there may be substantial benefits of malaria transmission reduction for older people, which have been overlooked in public health programmes and burden of

disease calculations. There is an urgent need for analysis of randomized controlled trial data on the effects of net use by older people on survival.

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